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ENVIRONMENTAL PROTECTION

VIRONMENTAL PROTECTION ELEMENT OF COMPREHENSIVE PLAN OF SAN FRANCISCO

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ENVIRONMENTAL PROTECTION ELEMENT OF THE COMPREHENSIVE PLAN OF SAN FRANCISCO

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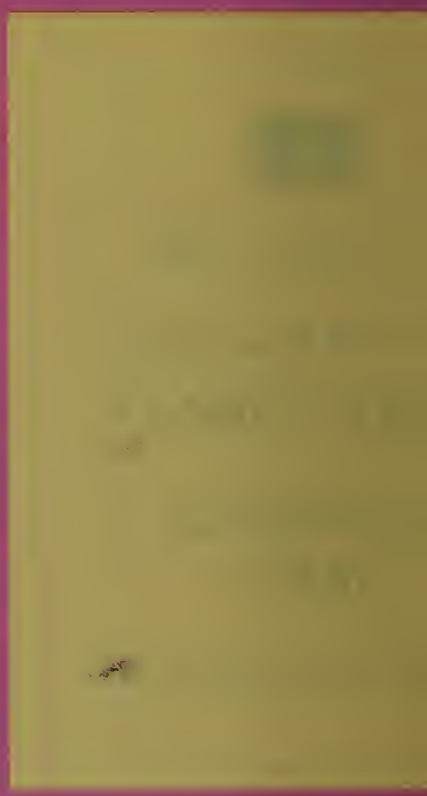

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SAN FRANCISCO DEPARTMENT OF CITY PLANNING 100 LARKIN STREET · SAN FRANCISCO, CALIFORNIA 94102

AUGUST, 1974

TO THE HONORABLE MEMBERS OF THE CITY PLANNING COMMISSION:

I am pleased to submit to you the accompanying report, TRANSPORTATION NOISE, A proposal for Citizen Review. This report is based on work done by acoustical engineering consultants, Bolt Beranek and Newman, Inc. The Department staff also secured the cooperation of engineering personnel within the Bureau of Engineering of the Department of Public Works.

The report shows present and projected noise levels throughout the city and discusses the implications of these noise levels for land use and transportation planning. In the plan section, objectives and policies are proposed for reducing the adverse impact of noise.

TRANSPORTATION NOISE is presented for citizen review to encourage discussion of proposed objectives and policies and of the suggested actions that can be taken to deal with transportation noise. The plan will be revised in accordance with worthwhile ideas and concerns offered during the public review period.

Following this period, the revised objectives and policies section will be presented to you for adoption as the transportation noise section of the ENVIRONMENTAL QUALITY element of the Comprehensive Plan.

Sincerely,

Allan B. Jacobs

Allan B. Jacobs
Director of Planning

SAN FRANCISCO DEPARTMENT OF CITY PLANNING 100 LARKIN STREET · SAN FRANCISCO, CALIFORNIA 94102

August 1974

We are pleased to send you this planning report entitled Transportation Noise. Proposed as an amendment to the City's Comprehensive Plan, it is being widely distributed to stimulate public comment on transportation noise issues and on the recommended objectives and policies for dealing with the problem.

The City Planning Commission intends to hold public hearings on the proposals to receive comments from individuals and organizations. The first hearing is scheduled for September 5th at 4:00 p.m. in Room 282, City Hall. The times and places of subsequent meetings will be announced at that hearing.

The recommendations will be revised on the basis of comments received at these hearings. We hope that you will feel free to assist us in planning for the control of transportation noise in San Francisco.

The Department staff will be available to discuss the report. If you have any questions, please call Sidney Shaw at 558-4541.

A PROPOSAL FOR CITIZEN REVIEW

TRANSPORTATION NOISE

THE COMPREHENSIVE PLAN OF SAN FRANCISCO

SAN FRANCISCO DEPARTMENT OF CITY PLANNING, AUGUST 1974

REF 388.4 T6878

Transportation noise :
the Comprehensive plan
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PREFACE

This report presents findings and proposals for dealing with the question of transportation noise in San Francisco. State planning legislation requires all local jurisdictions to include in their general plans a transportation noise element. In accord with established procedure for amending the City's Comprehensive Plan, this report is submitted as a proposal for citizen review. After individuals and groups have had the opportunity to study and comment on the proposals, the City Planning Commission will adopt portions of this report, as revised in response to citizen comment, as part of the Comprehensive Plan.

Technical investigations to ascertain present noise levels and estimate future levels were conducted by the firm of Bolt Beranek and Newman, Inc., under a contract with the Department. Their work was presented in a technical report available at the offices of the Department for pubic inspection. Much of that work, however, was incorporated in this proposal for citizen review. It formed the basis on which the staff of the Department developed proposals for ways to counteract excessive noise levels associated with surface transportation noises.

Throughout the study period, the staff received assistance and advice from the Mechanical Section of the Bureau of Engineering in the Department of Public Works. It should be stressed, however, that the recommendations in this report have not been endorsed by the Bureau of Engineering.

The report is organized into three main sections: findings, objectives and policies, and program for improvement. The objectives and policies comprise the plan section which will be recommended for adoption as the Transportation Noise Plan. The program section recommends actions that can be undertaken at the local level to deal with the noise problem as reported in the findings section.

Relation to Comprehensive Planning

The Transportation Noise Plan and the Conservation Plan (adopted May 24, 1973) will comprise the Environmental Protection Element of the Comprehensive Plan. This element represents another step in the general revision of the Comprehensive Plan.

INTRODUCTION

People who can clearly recollect the sights and sounds of San Francisco of 35 years ago remember how noisy the streets were then. Numerous cable cars and streetcar lines operated throughout the city. Market Street, with four sets of streetcar tracks, was extraordinarily noisy. The streetcars then were not the "quiet" PCC cars that are in use today. Automobiles, although much less numerous, were noisier than today's models. Then, of course, the bustling waterfront activity and vessels in the Bay further contributed to the sounds of the city.

Despite these noisy transportation systems, ambient or background noise levels over most of the city then were lower than now. Over the years, however, motor traffic--automobiles, trucks, and buses--has risen dramatically. Aircraft flights have multiplied. Today, in some parts of the city, background noise levels are so high that for many people, quiet can only be found inside a building with the windows shut.

We are learning that not only does noise annoy, it can endanger our physical and even mental health. Because of this potential health hazard, people are becoming convinced that we are as much entitled to a quiet environment as to unpolluted air and water and pure food.

Purpose of the Noise Element

Ground transportation noises--namely, trucks, buses, motorcycles, and poorly muffled automobiles--predominate over other noise sources as the most persistent cause for complaint. This is why the State legislation mandating this element of the Comprehensive Plan specifically mentions ground transportation facilities. Section 65302(g) of the California Government Code, added in 1972, requires all cities and counties to include a transportation noise element in their general plans, as follows:

> (g) A noise element in quantitative, numerical terms, showing contours of present and projected noise levels associated with all existing and proposed major transportation elements. These include but are not limited to the following:
>
> (1) Highways and freeways.
> (2) Ground rapid transit systems.
> (3) Ground facilities associated with all airports operating under a permit from the State Department of Aeronautics.

These noise contours may be expressed in any standard acoustical scale which includes both the magnitude of noise and frequency of its occurrence. The recommended scale is sound level A, as measured with A-weighting network of a standard sound level meter, with corrections added for the time duration per event and the total number of events per 24-hour period.

Noise contours shall be shown in minimum increments of 5 dB and shall be continued down to 65 dB(A). For regions involving hospitals, rest homes, long-term medical or mental care, or outdoor recreational areas, the contours shall be continued down to 45 dB(A).

Conclusions regarding appropriate site or route selection alternatives or noise impact upon compatible land uses shall be included in the general plan.

The State, local, or private agency responsible for the construction or maintenance of such transportation facilities shall provide to the local agency producing the general plan a statement of the present and projected noise levels of the facility, and any information which was used in the development of such levels.

San Francisco's noise control ordinance, adopted in 1972, deals essentially with noises that are unrelated to transportation. The Transportation Noise Plan, in offering guidelines for controlling transportation noise, supplements the ordinance.

Methodology

Study of the transportation systems in San Francisco, within the framework of the State legislation, led to the designation of the following systems as major noise sources:

- Freeways and other numbered State traffic routes.
- City streets with an evening peak-hour traffic volume of over 100 vehicles.
- Certain municipal transit routes.

Present and projected noise levels were derived from field measurements in combination with known techniques for calculating noise levels from reported traffic data. Identification of areas in which the prevailing noise levels were considered incompatible with the major activities in the areas formed the basis of a plan to reduce the level of environmental noise.

PART I - FINDINGS

DEFINING THE NOISE PROBLEM

Noise is a subjective evaluation of sound. While the physical properties of sound can be accurately described and measured, the human response to sound has been difficult to measure in meaningful terms. Implicit in the subjective evaluation of sound as noise--which does not always correlate exactly with loudness--is the judgment of the hearer that the sound is unwanted and of no positive value.

Characteristics of Sound

Sound is described in terms of three measurements:

(1) Intensity or pressure, which is measured in decibels (dB). Sound waves traveling outward from the source exert a force known as the sound pressure level (commonly called sound level), measured in decibels.

(2) Frequency or pitch, which is measured in cycles per second or Hertz (Hz). Low frequency sounds are produced by slowly vibrating objects and high frequency sounds by rapidly vibrating objects.

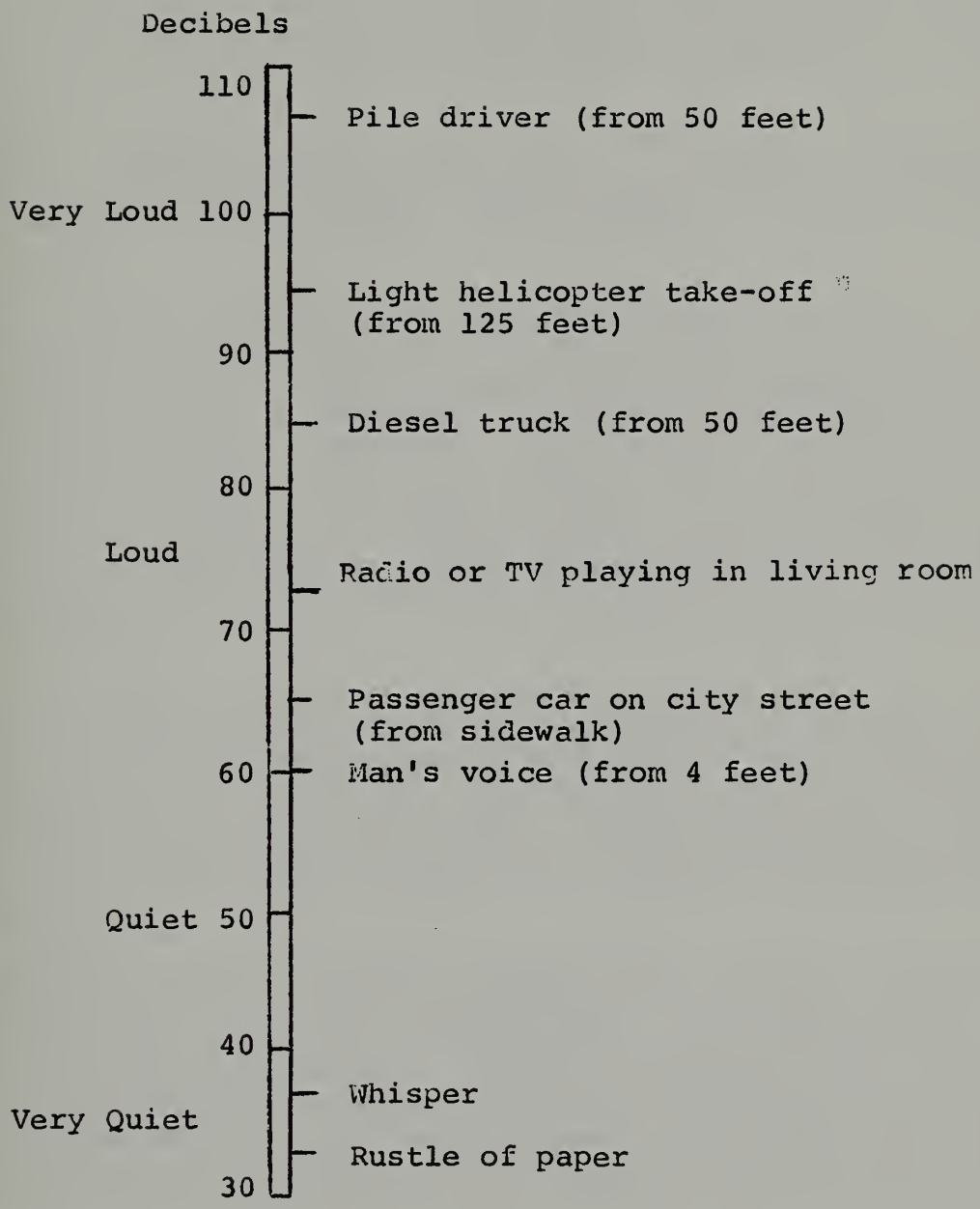
(3) Duration, which is measured in seconds, minutes, and hours.

Human sensitivity to sound depends on all three of these characteristics.

Zero decibel has been designated to describe the weakest or quietest sounds that can possibly be detected by the human ear. Typical everyday sounds range from 30 decibels (very quiet) to 100 decibels (very loud). The scale has a practical upper limit of 140 decibels.

The human ear, at least among the young, can hear sound frequencies from about 20 to 20,000 cycles per second. The ear, however, does not hear all frequencies or pitches equally well. It is more sensitive to higher than to lower frequencies. Thus, given two tones having the same sound pressure, a tone of 3,000 cycles per second sounds much louder to the ear than does a tone of 50 cycles per second.

Figure 1. TYPICAL NOISE LEVELS



To compensate for the differing sensitivity of the ear to different sound frequencies, a weighted scale of decibel measurements is commonly employed. Called the A-scale, it is built into sound level meters to take into account pitch as well as volume. The resulting decibel readings--designated as dB(A)--thus correspond closely to how people perceive sound. The references to decibels in this report refer to decibels measured on the A-scale.

Loudness is not perceived in direct proportion to measured sound level. Instead, to the human ear, a 10-decibel difference is judged as sounding twice (or half) as loud. Thus, 70 decibels is twice as loud as 60 decibels, and 50 decibels is half as loud as 60 decibels.

Adding sounds together can produce seemingly deceptive results. Because the decibel is measured on a logarithmic rather than linear scale, adding 60 decibels to 60 decibels does not produce 120 decibels but, instead, 63 decibels. Doubling the sound power always produces a three-decibel increase. Accordingly, two identical cars together make 3 decibels more sound than one car and four identical cars make 6 decibels more than one car. If two sounds, however, are of unequal intensity, the weaker sound adds less than three decibels to the louder sound. This effect continues to the point where a weaker sound with a 20-decibel difference adds nothing to the louder sound.

Sounds become quieter as the source gets farther away. For a single (or point) source, everytime the distance from the source is doubled, the sound level drops by 6 decibels. The opposite is true as the source gets closer. This relationship, however, does not hold true for a continuous stream of sound sources (such as freeway traffic) called a line source. Doubling or halving the distance from a line source results in a sound level change of only three decibels.

Except for the echo effect produced under special conditions, a single burst of sound quickly disappears. The repetition or duration of sounds, therefore, contributes significantly to a definition of the noise problem. Steady, intermittent, and impulsive sounds, for example, produce different reactions from listeners. These sound characteristics, then, together with pitch and loudness, largely determine when sound becomes subjectively evaluated as noise.

How Noise Affects Human Beings

Noise can produce a number of unwanted and unpleasant effects, depending on the characteristics of the sound and when it occurs. Here are the commonly observed undesirable effects of noise:

(1) Damage to hearing.

(2) Interference with conversation and other wanted sounds and signals.

(3) Interference with sleep.

(4) Interference with learning and work performance, especially tasks requiring thought and concentration.

(5) General irritation.

(6) Startle.

(7) Interference with privacy.

(8) Interference with mood and tranquility.

(9) Alteration of cardiovascular, endocrine, and neurologic functions.

Naturally, some of these effects are more readily produced than others. Sounds exceeding only 35-40 decibels, for example, are likely to awaken a sleeper or cause an unconscious shift in sleep level. At the other extreme, it takes many hours of noise over 90 decibels can cause permanent hearing damage. In general, however, noise levels above 70 decibels will cause discomfort and at least some interference with everyday activities.

Some types of noise seem more bothersome than others. Steady noises without any special content or meaning are not so disruptive as intermittent and impulsive noises. An example of this would be the steady roar of freeway traffic as compared to the sound of a barking dog. Pure tones, especially in the frequencies above 2,000 cycles per second, can be more annoying than low-frequency sounds or sounds containing a wide range of frequencies. Compare a whistle or the latest type of electronic siren with a fog horn or even a standard automobile horn. There is some comfort in the fact that transportation-related noises (except for tire noise at high speeds) typically fall in the lower sound frequency ranges.

PRESENT AND PROJECTED NOISE LEVELS

Under the State legislation and guidelines mandating preparation of a noise element, San Francisco is required to analyze the noise levels that transportation facilities presently produce and that they are expected to produce in the year 1995. The purpose in determining present and projected noise levels is to identify any areas or activities in the city that are now or may in the future be exposed to excessive noise. The plan is then to indicate what should be done about it.

The projection of noise levels to the year 1995 is admittedly a difficult task. So much depends on how strongly people will demand the application of available technology to reduce noise levels. Another major unknown is the outlook for continued reliance on the gasoline-powered engine. In fact, the spectre of growing fuel and other material shortages across the board casts doubt on the future of any individual means of transportation. Both the degree and style of mobility may be radically altered by the year 1995.

Because the crystal ball is cloudy, the most that can be done to estimate conditions in 1995 is to project current trends and rely on the application of legal restrictions within available technology. Even with these future uncertainties, however, the relationship that exists between traffic volumes and noise levels is such that perfect vision is not required. A doubling of traffic volume, for instance, results in only a 3 dB(A) rise in the noise level. On the other hand, significant changes can be expected when and if existing diesel trucks and buses and streetcars are replaced by quiet models.

To calculate the present and projected noise levels, the Department of City Planning engaged the services of Bolt Beranek and Newman, Inc., consultants in engineering and architectural acoustics. The results of their investigations, together with the supporting data, are continued in their Report No. 2806, entitled Noise In San Francisco (July, 1974). It is on file at the Department of City Planning.

Selection of the Day-Night Equivalent Sound Level Scale (L_{dn}) to Describe Noise Levels

Transportation noises vary in loudness throughout the day. Generally transportation noises drop during nighttime hours which is when people want and need a quieter environment. Because of this variability, both in noise levels and in human tolerance of them, using single-number values to describe noise levels must be carefully justified. A noise measurement based on human reaction

to the cumulative exposure to noise over a 24-hour period and taking into account the greater annoyance value of nighttime noises has been developed. This measurement, called the Day-Night Equivalent Sound Level (Ldn) rating scale, was selected as the most appropriate measurement of transportation-related noise. Recommended by the Environmental Protection Agency for use in describing the cumulative effect of exposure to all sources of environmental noise, it is based on the A-weighted scale of sound measurement. In measuring varying sounds over time, this method "translates" the fluctuating sound pressure level to a constant level having the same sound energy. A penalty correction factor of 10 dB is added to nighttime noise (from 10:00 p.m. to 7:00 a.m.). Considering the desire for greater quiet at night and the disturbing effect of noise intrusions that rise above the prevailing nighttime noise level, this nighttime penalty makes sense. For a single-number characterization of 24-hour noise levels, then, the Ldn scale comes close to quantifying with proper subjectivity the cumulative exposure to noise.

Because the Day-Night Equivalent Sound Level is based on sound energy, a sound with twice the energy but lasting only half as long as another sound has the same value; so does a sound with four times the energy but lasting only one-quarter as long. A short blast that shatters the silence may be equivalent to a constant hum. This apparent disadvantage, however, is not considered significant when it comes to measuring community noise.

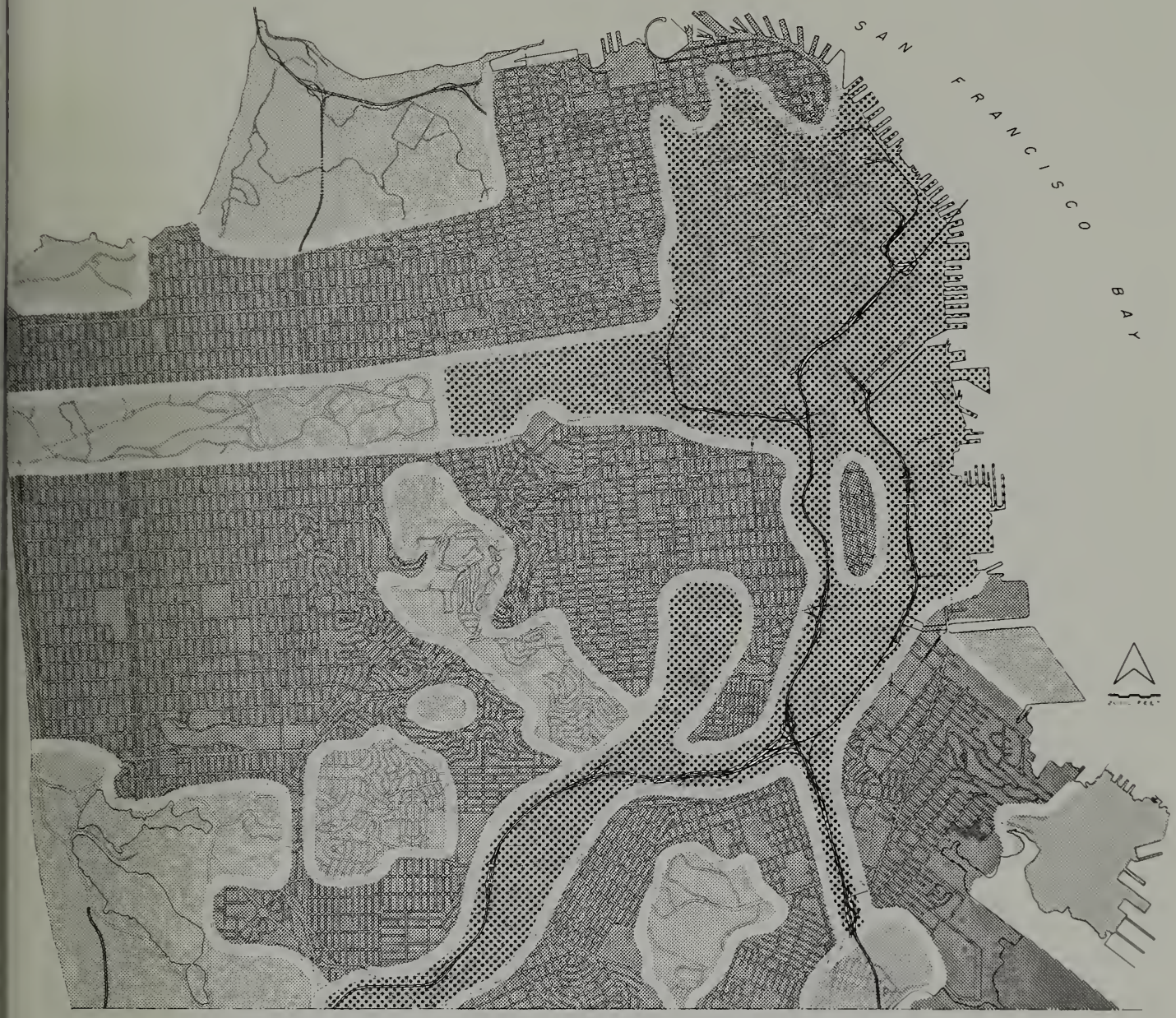
Present Noise Levels - 1974

The transportation noise picture in San Francisco has two aspects:

(1) Background noise, largely attributable to transportation sources;

(2) Noise produced by traffic (including rail transit) on specific traffic arteries. These noise levels are portrayed on two maps: Map 1, Background Noise Levels - 1974; and Map 2, Thoroughfare Noise Levels - 1974.

The portrayal of thoroughfare noise levels as single lines matches reality better than the noise contour technique suggested by the State legislation. The latter technique appropriately portrays noise radiation outward with no intervening structures. In San Francisco, however, most traffic arteries are lined with buildings. Noise contours actually rise up the face of the buildings and over the rooftops, only to disappear into the general background noise at the rear of the buildings. There are numerous exceptions to this, of course, among which are the openings at every street



MAP I. BACKGROUND NOISE* LEVELS-1974

LEGEND L_{dn} = Noise Levels in Decibels (Day/Night Equivalent, L_{dn})

PAINFULLY LOUD	120	
	110	Pile Driver at 50 feet
	100	
VERY LOUD		GMC 8-Cylinder Muni Bus Accelerating at 15 feet
	90	Muni Streetcar, 25mph at 25 feet
	80	
LOUD	70	Typical Passenger Car, 25mph at 25 feet
	60	Normal Speech at 3 feet
		Acceptable Residential Outdoor Level-EPA
	50	
QUIET		Small Town Residential Cul-de-Sac
	40	Whisper at 3 feet
VERY QUIET	30	

*Background Noise:
The general din of street noises excluding all separate, distinguishable noise events

MAP 2. THOROUGHFARE NOISE LEVELS - 1974

LEGEND L_{dn} = Noise Levels in Decibels (Day/Night Equivalent, L_{dn})

PAINFULLY LOUD	120	
	110	Pile Driver at 50 feet
	100	
VERY LOUD		GMC 8-Cylinder Muni Bus Accelerating at 15 feet
	90	Muni Streetcar, 25mph at 25 feet
	80	
LOUD	70	Typical Passenger Car, 25mph at 25 feet
	60	Normal Speech at 3 feet
		Acceptable Residential Outdoor Level - EPA
	50	
QUIET		Small Town Residential Cul-de-Sac
	40	Whisper at 3 feet
VERY QUIET	30	

intersection, but a meticulous mapping of all these conditions would constitute a formidable task. For these reasons, the selected technique was deemed suitable for San Francisco.

1. Background Noise Levels (1974)

Background noise, sometimes called ambient or residual noise, is the result of many sources over a wide area and is heard as a general roar of undifferentiated sound. While the background noise level may rise and fall over a 24-hour period, it is always there as a measurable sound energy. Any noise can contribute to the background noise level, but the major contributions come from transportation sources. A freeway, for instance, is bound to affect the background noise level of a considerable area around it.

As Map 1 shows, background noise levels are already high in San Francisco. This is not surprising considering the population concentrations found in this very densely built city. In a small city, away from any major traffic arteries, background noise would range from 40 to 50 decibels on the Ldn scale. In San Francisco, the 55 Ldn noise level--identified by the EPA as the environmental noise level in residential areas requisite to protect public health and welfare (with a 5-decibel margin of safety)--is met only in a comparatively small part of the city. If the 5-decibel margin of safety factor is ignored, then most of the city would meet the less stringent "standard."

These background noise levels, ranging from 55 to 65 Ldn, are characteristic only of locations away from busy thoroughfares and of the backyard areas behind rowhouse streets. This latter condition is common in San Francisco and is a happy result of the local tradition of building attached dwellings. These rows of buildings form a significant barrier between the street traffic and the rear yards. So prevalent, in fact, is this building style in San Francisco, that background noise levels tend to be approximately five decibels lower than would be expected from a relationship between noise level and population density that has been observed in other cities.

2. Thoroughfare Noise Levels (1974)

Background noise levels are not applicable at the façade of a building that fronts on a heavily

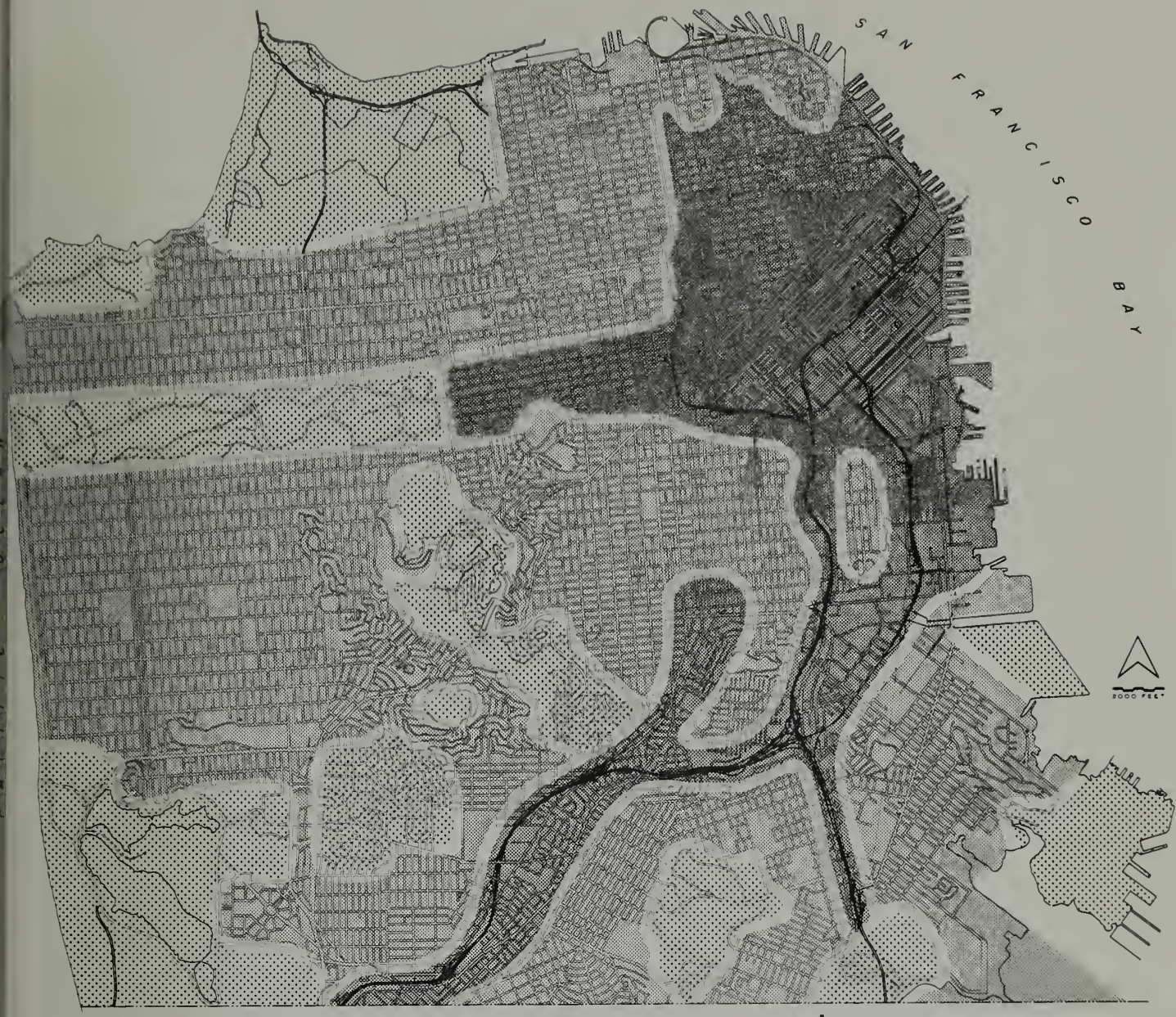
traveled thoroughfare. Map 2 assigns to thoroughfares with an evening peak-hour traffic volume of over 100 vehicles a noise level that would be found at the façade of a building located 50 feet from the centerline of the thoroughfare. The noise levels in Ldn decibel values range in 5-decibel increments from a high of 80 down to 65. In general, the noise level along a thoroughfare varies logarithmically with the traffic flow rate: a tenfold increase in hourly traffic flow increases the noise level by 10 decibels, judged subjectively as a doubling of the loudness.

In San Francisco, some streets have higher noise levels than might be expected from just the automobile and truck traffic. The higher-than-expected noise levels are due to the operation of Municipal Railway diesel buses, streetcars, and cable cars on these streets. Examples of such streets are Haight, Judah, and Hyde Streets. In fact, during the shutdown of the Municipal Railway in March, 1974, Market Street in the vicinity of Leavenworth Street was approximately 10 decibels quieter than it ordinarily is! Based on sound level measurements, ten Muni diesel buses, streetcars, or cable cars per hour produce the noise equivalent of 700 passenger cars per hour. Muni vehicles are unquestionably a significant source of noise in the city.

Projected Noise Levels - 1995

Transportation noise is a function of both the number of vehicles and the noise output of the vehicles themselves. Barring unforeseen events, basic traffic patterns on San Francisco streets are not expected to change enough between now and 1995 to cause a perceptible change in the noise levels generated. The projected drop in noise levels by 1995 is due, instead, to an expected drop in the noise that individual vehicles will produce.

Both the Federal government and the State of California are involved in efforts to reduce the noise output of motor vehicles (see the part of this report on Existing Programs in the section entitled PROGRAM FOR IMPROVEMENT). Enforcement of the California law limiting the noise output of all new vehicles to 70 decibels by 1988, together with the attrition of the majority of pre-1988 private vehicles by the year 1995, will result in an appreciable reduction of vehicular noise levels. Average automobile noise will drop approximately 5 decibels and buses approximately 10 decibels. Streetcar noise will be reduced by approximately 5 decibels, but cable car noise will remain unchanged. The effects of all this are portrayed on Map 3, Projected Background Noise Levels - 1995, and Map 4, Projected Thoroughfare Noise Levels - 1995.



MAP 3. PROJECTED BACKGROUND NOISE* LEVELS-1995

LEGEND L_{dn} = Noise Levels in Decibels (Day/Night Equivalent, L_{dn})

PAINFULLY LOUD	120	
	110	Pile Driver at 50 feet
VERY LOUD	100	GMC 8-Cylinder Muni Bus Accelerating at 15 feet
	90	Muni Streetcar, 25mph at 25 feet
	80	
LOUD	70	Typical Passenger Car, 25mph at 25 feet
	60	Normal Speech at 3 feet
		Acceptable Residential Outdoor Level- EPA
	50	
QUIET		Small Town Residential Cul-de-Sac
	40	Whisper at 3 feet
VERY QUIET	30	

*Background Noise:
The general din of street noises excluding all separate, distinguishable noise events.

MAP 4. PROJECTED THOROUGHFARE NOISE LEVELS-1995

LEGEND L_{dn} = Noise Levels in Decibels (Day/Night Equivalent, L_{dn})

PAINFULLY LOUD	120	
	110	Pile Driver at 50 feet
	100	
VERY LOUD		GMC 8-Cylinder Muni Bus Accelerating at 15 feet
	90	Muni Streetcar, 25mph at 25 feet
	80	
LOUD	70	Typical Passenger Car, 25mph at 25 feet
	60	Normal Speech at 3 feet
		Acceptable Residential Outdoor Level-EPA
	50	
QUIET		Small Town Residential Cul-de-Sac
	40	Whisper at 3 feet
VERY QUIET	30	

AN FRANCISCO DEPARTMENT OF CITY PLANNING

1. Projected Background Noise Levels (1995)

The pattern of background noise levels projected for the year 1995 is similar to that for 1974 except that the noise levels have been lowered by 5 decibels. This reduction results directly from the drop in vehicular noise output anticipated by the year 1995. Away from the busy thoroughfares, background noise levels over the major part of the city will meet the 55 Ldn level currently identified by the EPA as requisite to protect the public health and welfare, with a 5-decibel margin of safety, in residential areas.

2. Projected Thoroughfare Noise Levels (1995)

Map 4, Projected Thoroughfare Noise Levels - 1995, illustrates the noise levels expected on San Francisco streets by 1995. The range of Ldn values is the same as for 1974, but the majority of the streets are indicated as being 5 decibels quieter in 1995 than they were in 1974. Again, the 5-decibel change results from the reduction in individual vehicle noise emission levels.

Municipal Railway vehicles, especially cable cars, will still make a significant contribution to the noise levels. The cable cars are not expected to be any quieter in 1995 than they are now. The subway-surface cars (streetcars) now on order will still be in operation in 1995. By then, the present fleet of diesel buses will have been retired, but the 1995 fleet is still expected to include many vehicles of pre-1988 vintage.

IDENTIFYING NOISE-IMPACTED AREAS OF THE CITY

Noise pollution adversely affects the city as a place to live, work, and play. Dwellings subjected to high traffic noise levels become less desirable.

Outside noise levels are high in commercial and industrial parts of San Francisco. Sometimes interior noise levels are no lower. This is not always true, however, and good, rentable office space typically is constructed with substantial noise insulation. This does not help those, however, who may be trying to carry on a conversation outside. Noise pollution, in fact, can impair the usability of outdoor area for recreation and relaxation.

Based on observation of how noise levels interfere with the performance or enjoyment of various activities, standards have been developed to express the compatibility of land uses with specific noise levels. With these standards, the present and projected noise levels are matched against existing and anticipated land uses to determine the areas of the city that are or may in the future be exposed to undesirable noise levels.

Noise Compatibility Standards for Land Uses

The relationships between noise and performance of critical tasks have for years been a concern of a number of Federal agencies--Federal Aviation Administration, Department of Housing and Development, Federal Highway Administration, Public Health Service, and Environmental Protection Agency. In California, State regulatory and operating agencies are also concerned. The standards presented below draw on this field of individual and community reactions to noise.

Although hearing damage is the most obvious health hazard to be avoided through noise control, exposure to everyday noise levels, for the average person, rarely presents this hazard. For this reason, interference with sleep and with communication is a practical standard that can be applied in determining acceptable outdoor noise levels in most situations. Add to this the desire for quiet in places such as libraries, classrooms, and parks, and it becomes possible to develop a system of noise tolerance standards for categories of land use.

All buildings offer some insulation against the intrusion of outside noise. The table following shows the typical noise reduction achieved by different building types and window conditions, without any other particular noise insulation materials:

Noise Reduction Achieved by Exterior of Structures

Building Type	Window Condition	Reduction of Noise From Outside Sources
All	Open	10 decibels
Light frame	Ordinary sash, closed	20 decibels
Masonry	Single pane, closed	25 decibels
Masonry	Double pane, closed	35 decibels

Source: FHWA Policy and Procedure Memorandum 90-2, February 8, 1973.

These relationships between outdoor and indoor noise levels are crucial to judging how compatible different land uses are with different noise levels.

Figure 2, showing noise compatibility standards for land uses, is adapted from the corresponding chart presented in Bolt Beranek and Newman's report to the Department, Noise In San Francisco (1974). The modifications were made both to simplify the guidelines and to recognize the impact of State noise insulation requirements.

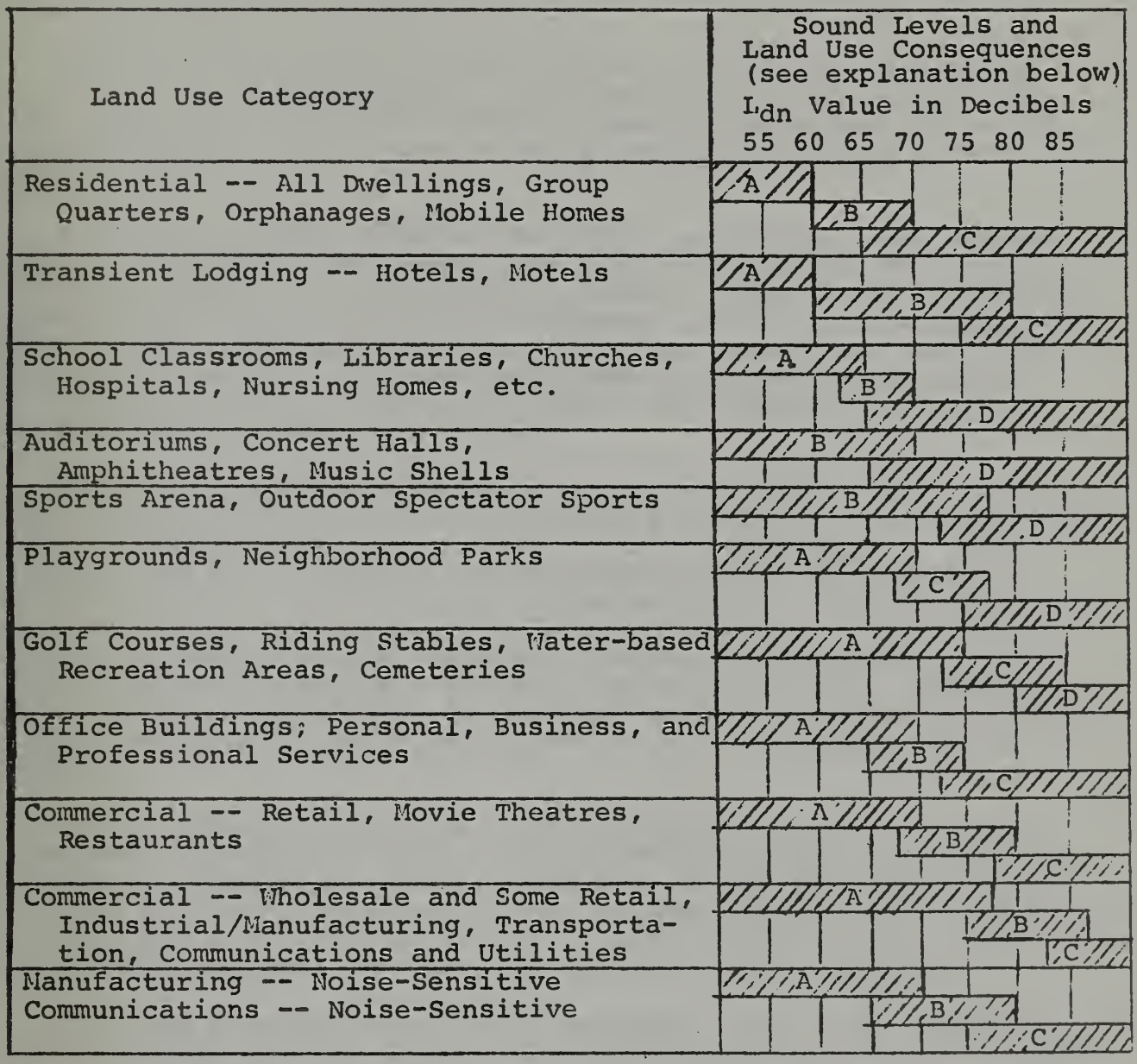
Areas Subject to Unacceptable Noise Levels

The designation of an area as noise-impacted or subject to unacceptable noise levels seemingly should have some relation to the sentiment of those who live, work, and visit the area. On the other hand, it may be a disservice to these same people--whether they realize it or not--to infer from a complacency about noise or adjustment to it that no noise problem exists. San Franciscans who do complain about noise tend to be disturbed by particular sources rather than background noise. Steady noise is generally regarded as less disruptive than fluctuating or intermittent noise. High background noise levels in some parts of the city, therefore, may not pose a significant problem for many people.

The impact of 1974 high thoroughfare noise levels on adjacent land uses constitutes a serious problem in the city. To a lesser extent, the problem is projected for the year 1995. The probable impact on residential uses--including transient lodging and nursing homes--is particularly acute. More than half of the city's major thoroughfares are lined with residences. Even where businesses stretch along these busy arteries, residences frequently are found above the ground floor. The most seriously affected areas are:

Downtown and Nob Hill
South of Market
Western Addition
Mission District
Richmond District
Marina District

Figure 2. LAND USE COMPATIBILITY CHART FOR COMMUNITY NOISE


Land Use Category
Sound Levels and Land Use Consequences (see explanation below)
L_{dn} Value in Decibels
55 60 65 70 75 80 85
Residential -- All Dwellings, Group Quarters, Orphanages, Mobile Homes
Transient Lodging -- Hotels, Motels
School Classrooms, Libraries, Churches, Hospitals, Nursing Homes, etc.
Auditoriums, Concert Halls, Amphitheatres, Music Shells
Sports Arena, Outdoor Spectator Sports
Playgrounds, Neighborhood Parks
Golf Courses, Riding Stables, Water-based Recreation Areas, Cemeteries
Office Buildings; Personal, Business, and Professional Services
Commercial -- Retail, Movie Theatres, Restaurants
Commercial -- Wholesale and Some Retail, Industrial/Manufacturing, Transportation, Communications and Utilities
Manufacturing -- Noise-Sensitive
Communications -- Noise-Sensitive
A
B
C
D

Explanation of Land Use Consequences

A. Satisfactory, with no special noise insulation requirements.
B. New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design.
C. New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design.
D. New construction or development should generally not be undertaken.

In addition, property along all the routes through San Francisco to the Peninsula is similarly affected.

The 1974 thoroughfare noise levels are too high, according to the land use compatibility guidelines, for many types of businesses that do not have some form of insulation against the noise. By 1995, however, this situation with respect to business uses will have improved.

A special problem affects the city's hospitals. All the major hospitals and many convalescent hospitals are located on streets with an Ldn value of 65 decibels or greater. San Francisco General Hospital, now being rebuilt, lies between an Ldn 80 freeway and an Ldn 75 street. Because large hospitals are themselves such heavy traffic generators, it seems appropriate to locate along major arteries. Renovation that incorporates noise-reducing materials may, therefore, be the best answer.

The City's parks and recreation areas are variously affected. Nearby traffic noise is not so disturbing in active recreation areas as it is in park areas designed for rest and relaxation. Golden Gate Park and the Panhandle are surrounded and invaded by heavy traffic. Other recreation areas affected by high traffic noise are the Marina Green, Lake Merced, Balboa Park, Dolores Park, Union Square, Portsmouth Square, Hamilton Square, Raymond Kimbell Playground, Funston Playground, and St. Mary's Playground. Again, by 1995, the noise environment is expected to have improved by approximately 5 decibels, roughly equivalent to a 50 percent decrease in loudness.

Except possibly for a few strictly outdoor activities, projected 1995 background noise levels present no special problem for any type of activity or land use category in any part of the city. Away from the busy thoroughfares and in the backyard interiors of San Francisco's ubiquitous rowhouse blocks, outdoor noise levels are projected to meet the land use compatibility guidelines.

The 1995 transportation noise problems, therefore, typically will be confined to the façades of buildings along certain thoroughfares. In many situations, outdoor noise intrusion could be adequately reduced simply by treating one wall, or, with a corner building, two walls. The areas of the city that are projected by 1995 to be adversely affected by thoroughfare noise are essentially the same areas that presently feel the impact. In most cases, however, the noise levels will have dropped by five decibels.

Although not portrayed on the noise level maps, BART is expected to exert a limited noise impact in 1995 along its elevated section of track. Running for approximately one and one-half miles and terminating in Daly City, train operations on this elevated structure will add two decibels to the Ldn value of the adjacent and parallel Southern Freeway.

Given the picture of present and projected impact of transportation noise in San Francisco, several planning issues arise:

(1) Is it sufficient to rely on the gradual improvement in the noise environment that the 1995 projections promise?

(2) What needs to be done to assure that the projected improvement will be achieved?

(3) Should steps be taken to hasten the achievement of this projected improvement?

(4) Considering the noise problems that will remain unresolved even with the 1995 projections, what actions can be taken to improve upon the projections?

The following section of this report proposes a number of objectives and policies for guiding future actions related to transportation noise and its impact on human activities. Following that, the program section describes some noise control activities already in existence and proposes a number of specific actions that may be taken by the City to carry out and accelerate a program for transportation noise control.

PART II - PLAN FOR TRANSPORTATION NOISE CONTROL

OBJECTIVES AND POLICIES

The transportation noise plan is directed toward achieving an environment in which noise levels will not interfere with the health and welfare of people in their everyday activities. Much of the adverse effect of transportation noise can be reduced through sound land use planning and transportation planning. How those elements of the general planning process are implemented is crucial to achieving the goal of a quieter environment. However, in a fully developed city, such as San Francisco, where the land use and circulation patterns are by and large fixed, the ability to reduce the noise impact through a proper relationship of land use and transportation facility locations is limited. In San Francisco, major attention must be given to three main aspects of the problem: the source of the noise, the path it travels, and the receiver of the noise. In general, techniques should be designed to quiet the noise at the source, to block the path over which it is transmitted, and to shield or remove the receiver from the noise.

OBJECTIVE 1. REDUCE TRANSPORTATION-RELATED NOISE

Much can be done to reduce noise at the source. Technological means are available for reducing vehicular noise emissions well below present levels. The legal and political considerations in achieving these reductions thus become crucial.

Policy 1. Enforce noise emission standards for vehicles.

The noise emission standards of the State Vehicle Code are enforced by the California Highway Patrol on the freeways, and by the local police on the city streets. The Noise Abatement Unit of the Police Department has been actively engaged in identifying vehicles that violate the noise emission standards and in securing the correction of the problem. This work should be continued and expanded.

Policy 2. Impose traffic restrictions to reduce transportation noise.

Transportation noise levels vary according to the predominance of vehicle type, traffic volume, and traffic speed. Curtailing any one of these variables ordinarily produces a drop in the noise level. In addition to setting the speed limit, the City has the

authority to restrict traffic on city streets, and it has done so on a number of streets. In addition, certain movement restraints can be applied to slow down traffic or divert it to other streets. These measures should be employed where appropriate to reduce noise.

Policy 3. Limit City purchases of vehicles to models with the lowest noise emissions and adequately maintain City-owned vehicles and travel surfaces.

The City owns and operates over a thousand vehicles in addition to its large fleet of automobiles. Street noise performance specifications for City vehicles (transit; trucks; specialized vehicles, such as street sweepers, brush chippers, etc.) should be included in the purchasing procedures of the City so that the City will obtain the quietest available models.

With proper maintenance, the City's inventory of vehicles can be kept in good working order, thereby reducing the noise they generate. Proper emphasis must also be placed on smooth street surfaces and on smooth rails for the streetcars and cable cars. Trackbeds for the rail vehicles also require special attention as do the various underground elements of the cable car traction system.

Policy 4. Regulate use of emergency sirens.

Police vehicles, fire engines, and ambulances, in their function as emergency vehicles, are entitled to the use of emergency warning sirens. Under State law, sirens must produce a sound level of at least 90 decibels at 100 feet. Many persons find these sirens--especially the newer warbling type--annoying. The warbling siren should be replaced by conventional sirens and measures should be taken to assure that the use of all sirens is restricted to assuring the emergency vehicle the right-of-way only in genuine emergencies.

Policy 5. Retain and expand the electric trolley network.

Electric trolley buses are quiet, economical, and relatively pollution-free in their use. These benefits outweigh the adverse environmental impact of power generation or fossil fuel utilization. Electric trolleys should be retained where feasible and consideration should be given to electrifying selected existing diesel bus routes.

Policy 6. Discourage changes in streets which will result in greater traffic noise in noise-sensitive areas.

Widening streets for additional traffic lanes or converting streets to one-way direction can induce higher traffic volume and

faster speeds. Other techniques such as towaway lanes and traffic light synchronization also facilitate heavier traffic flows. Such changes should not be undertaken on residential streets if they will produce an excessive rise in the noise level of those streets.

OBJECTIVE 2. MINIMIZE THE IMPACT OF NOISE ON AFFECTED AREAS

The process of blocking excessive noise from our ears could involve extensive capital investment if undertaken on a systematic, citywide scale. Selective efforts, however, especially for new construction, are both desirable and justified.

Policy 1. Promote site planning, building orientation and design, and interior layout that will lessen noise intrusion.

Because sound levels drop as distance from the source increases, building setbacks can play an important role in reducing noise for the building occupants. (Of course, if provision of the setback eliminates livable rear yard space, the value of the setback must be weighed against the loss of the rear yard.) Buildings sited with their narrower dimensions facing the noise source and sited to shield or be shielded by other buildings also help reduce noise intrusion. Although walls with no windows or small windows cut down on noise from exterior sources, in most cases it would not be feasible or desirable to eliminate wall openings. However, interior layout can achieve similar results by locating rooms whose use require more quiet, such as bedrooms, away from the street noise. In its role of reviewing project plans and informally offering professional advice on site development, the Department of City Planning can suggest ways to help protect the occupants from outside noise, consistent with the nature of the project and size and shape of the building site.

Policy 2. Promote the incorporation of noise insulation materials in new construction.

State-imposed noise insulation standards apply to all new residential structures except detached single-family dwellings. Protection against exterior noise and noise within a building is also important in many nonresidential structures. Builders should be encouraged to take into account prevailing noise levels and to include noise insulation materials as needed to provide adequate insulation.

Policy 3. Construct physical barriers to reduce noise transmission from heavy traffic carriers.

If designed properly, physical barriers, such as walls and berms, along transportation routes can in some instances effectively

cut down on the noise that reaches the areas beyond. There are opportunities for a certain amount of barrier construction, especially along limited access thoroughfares and transit rights-of-way (such as BART), but it is unlikely that such barriers can be erected along existing arterial streets in the city. Barriers are least effective for those hillside areas above the noise source. Where feasible, appropriate noise barriers should be constructed.

OBJECTIVE 3. PROMOTE LAND USES THAT ARE COMPATIBLE WITH VARIOUS TRANSPORTATION NOISE LEVELS.

Because transportation noise is going to remain a problem for many years to come, attention must be given to the activities close to the noise. In general, the most noise-sensitive activities or land uses should ideally be the farthest removed from the noisy transportation facilities. Conversely, those activities that are not seriously affected by high outside noise levels can be located near these facilities.

Policy 1. Discourage new uses in areas in which the noise level exceeds the noise compatibility guidelines for that use.

New development should be examined to determine whether background and/or thoroughfare noise level of the site is consistent with the guidelines for the proposed use. If the noise levels for the development site, as shown on the following maps*, exceed the sound level guidelines established for that use, as shown in the land use compatibility chart*, then either needed noise insulation features should be incorporated in the design or else the construction or development should not be undertaken. Since the sound levels shown on the maps are estimates based both on traffic data and on a sample of sound level readings, actual sound levels for the site, determined by accepted measurement techniques, may be substituted for them.

Policy 2. Consider the relocation to more appropriate areas, those land uses which need more quiet and cannot be effectively insulated from noise in their present location, as well as those land uses which are noisy and are presently in noise-sensitive areas.

Many commercial and industrial activities do not need to be in a quiet area, because interior noise levels typically are already high and tend to override noise from exterior sources. On the other

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*The maps presently appear following Pages 6 and 8 and the chart appears on Page 12 of the Findings Section. In the adopted Comprehensive Plan element, which will not include the Findings Section, they will appear at this point.

hand, some uses require quiet locations and cannot be effectively insulated from noise. When feasible and desirable to do so, such activities should be encouraged to relocate to quieter areas. Conversely, there may on occasion be opportunities to relocate noisy uses to areas where the noise they generate will be less disturbing to their neighbors.

Policy 3. Locate new noise-generating development so that the noise impact is reduced.

Developments which will bring appreciable traffic into or through noise-sensitive areas should be discouraged, if there are appropriate alternative locations where the noise impact would be less. For those activities--such as a hospital--that need a quiet environment, yet themselves generate considerable traffic, the proper location presents a dilemma. In those cases, the new development should locate where this traffic will not present a problem and, if necessary, incorporate the proper noise insulation.

The feasibility of making noise-reducing changes to existing transportation facilities remains an obstacle to any large-scale transformation. New thoroughfares and new Municipal Railway facilities, however, offer opportunities to overcome objectionable noise aspects. Ideally, new transportation facilities should be located in areas or along routes of least noise-sensitive land uses. Where it is infeasible or undesirable to do so, special noise-suppressing design features should be incorporated into the facilities in order to make them acceptable neighbors.

PART III - PROGRAM FOR IMPROVEMENT

The 1995 projected noise levels indicate that unless additional steps are taken many San Franciscans may continue to be subjected to excessive noise levels. Although this prediction takes into account certain probable technological and legal restraints, further actions may be undertaken to improve projected conditions. This section describes some ways by which the 1995 projections can be attained and even exceeded.

The objectives and policies for noise control indicate that an improvement program must be both remedial and preventive. Experience of Federal and State programs, however, has shown that remedial programs can be costly. This in itself offers a good reason for preventing noise problems from developing. The following program for improvement explains existing Federal, State, and local programs and proposes a number of actions to achieve noise reduction and avoid further noise pollution.

EXISTING PROGRAMS

The growing volume of transportation operations has produced more insistent pleas for government to legislate away one of the unwanted by-products--noise. At the Federal, State, and local levels, programs are under way to help stop--and, where possible, reverse--the growth of noise pollution from transportation sources. The success of any or all of these programs will depend on continued support by the public who, in the final analysis, must bear the costs of noise control.

1. Environmental Protection Agency (EPA)

The Federal Noise Control Act of 1972 gave EPA authority in the following areas:

(1) To set noise-emission standards for the operation of equipment and facilities of interstate railroads, trucks, and buses.

(2) To set noise-emission standards for domestically manufactured and imported transportation equipment (except aircraft), construction equipment, all motors and engines, and electrical and electronic equipment.

(3) To advise the Federal Aviation Administration (FAA) in formulating standards for controlling aircraft noise.

(4) In connection with the above activities, and for general educational purposes, to conduct and publish studies on noise standards and control.

The Noise Control Act of 1972 represents the first major Federal attempt to eliminate excessive noise at the design stage of transportation and other equipment. EPA-adopted standards pre-empt State and local regulations on the same subject, but the use and operation of this same noise-emitting equipment still fall within local jurisdiction so long as the Federal standards are not directly violated or thwarted.

The truck noise limit, for example, has been set at 90 decibels, measured on the A-scale, for trucks over 10,000 pounds traveling at speeds over 35 miles per hour, at a distance of 50 feet. This limit, in addition, applies to a truck loaded and/or on grade; a partially loaded truck, traveling on a level highway, would obviously produce less noise. So would a truck going at speeds under 35 miles per hour. In fact, the limit for the same truck on a level highway and at speeds equal to or under 35 miles per hour is 80 decibels, which is only half as loud as 90 decibels. Although many trucks can easily attain these limits, some, especially the large diesel trucks, will need special mufflers and tires to achieve compliance. These and other standards limiting transportation equipment noise are only the starting point for reducing noise on streets and highways.

In its investigations of acceptable community noise levels, the EPA has identified noise levels that will protect the public health and welfare in nearly all situations. In residential areas, for example, an Ldn of 55 decibels outdoors and a corresponding indoor Ldn of 45 decibels are identified as maximum noise levels for protecting the public health and welfare from adverse effects of interference with speech and other activities. These levels include a five-decibel margin of safety.

2. Federal Aviation Administration (FAA)

Although the number of aircraft operations are likely to multiply in the next ten years, the problem of noise from aircraft flyovers is not dealt with in this Comprehensive Plan element. This is because the FAA has full jurisdiction over aircraft noise as a result of Federal legislation passed in 1968, and thus local action is preempted. The Noise Control Act of 1972, however, authorized the EPA to make a comprehensive study of aircraft noise and noise around airports, and to advise the FAA regarding regulations to control aircraft noise and sonic booms. The FAA remains free to accept reject, or modify any such proposals.

The FAA is approaching the problem of reducing aircraft noise in two ways:

(1) Certification of airplanes to assure their conformity with adopted noise standards contained in the Federal Air Regulations.

(2) Two-segment landing procedures for incoming airplanes at designated airports.

While the new wide-bodied jets already meet FAA noise regulations, many older jets do not. Engines of these nonconforming planes will have to be retrofitted with sound-absorbing material. To facilitate the two-segment landing procedures, on-ground guidance equipment must be installed at the designated airports.

3. California Division of Aeronautics

Under the California Public Utilities Code, the Division of Aeronautics sets noise standards for the operation of aircraft and aircraft engines for all airports operating under a State permit, which includes all but military fields.

The noise regulations are intended to produce a lowering of noise associated with the airports' activities. The means for achieving this reduction are based on the proprietary authority of the airport to regulate the design and use of airport facilities and the regulatory authority of local government to control land use in the vicinity.

Pursuant to the noise control regulations of the Division of Aeronautics, San Francisco International Airport has established a Noise Monitoring System and Sound Abatement Center. The Noise Monitoring System will identify each of the over 900 daily aircraft operations and measure the noise of these operations from each of 14 separate locations outside the airport. The Sound Abatement Center, composed of airport and airline personnel, works toward implementing specific noise abatement programs.

A noise impact boundary, defining the real limit of objectionable noise levels, must be established by the end of 1975. Thereafter, the boundary must be progressively pulled in toward the airport and away from adversely affected land uses. By 1986, the noise level around San Francisco International Airport must be reduced to a value roughly approximately Ldn 65 in all nearby residential areas.

The Regional Airport Systems Study sponsored by the Association of Bay Area Governments (ABAG) found that 1970 operations at San Francisco International Airport did not have an adverse impact on the city itself, within the standard established by the Division of Aeronautics. Projections for 1985 showed even less of an impact. Subsequent to this study, Wyle Laboratories studied present and projected flight patterns and projected an even greater reduction in the impacted area than indicated in the earlier study.

4. Federal Highway Administration (FHWA)

Included in the Federal-Aid Highway Act of 1970 was authorization for the U.S. Department of Transportation (DOT), of which FHWA is a part, to set standards for highway noise levels compatible with different land uses, with due consideration to other social, environmental, and economic effects. To be eligible for Federal aid, all highways must include noise abatement features (unless granted an exception) to obtain design noise levels in the standards.

5. California Department of Transportation (Cal-Trans)

Recognizing that daytime noise levels of freeways are high, Cal-Trans is engaged in a program to mitigate this impact on schools adjacent to freeways. A 1970 amendment to the Business and Transportation Code forbids new freeways if they will raise the noise level inside public schools to more than 50 decibels. The State, however, has the option of acoustically treating the schools to prevent the noise increase in the classrooms.

In addition, Cal-Trans is taking measures to reduce noise in existing schools, both public and private, near freeways already constructed. These measures usually take the form of insulating the exterior walls or constructing a noise barrier along the edge of the freeway. The goal, again, is to reduce noise, where necessary, to a maximum of 50 decibels in the classrooms.

6. California Vehicle Code

The Vehicle Code has set noise emission standards both for the sale of and operation of licensed motor vehicles in California. Standards are based on the measurement of sound levels at a distance of 50 feet from the centerline of travel under established test procedures. The present operation standards (Section 23130) are the following:

	Maximum Permitted Noise (Decibels on the A-Scale)	
Vehicle	Speed Limit of 35 MPH or Less	Speed Limit of More Than 35 MPH
Vehicle weighing 6,000 lbs. or more	86	90
Motorcycle	82	86
Other vehicle	76	82

These operation standards are enforced by the California Highway Patrol on freeways and by local police on City thoroughfares.

Section 27160 governing the sale of new motor vehicles sets the following standards under test procedures established by the Department of Motor Vehicles:

Vehicle	Maximum Permitted Noise (Decibels on the A-Scale)
Vehicle weighing 6,000 lbs. or more	
• Mfd. before 1975	86
• Mfd. after 1974 and before 1978	83
• Mfd. after 1977 and before 1988	80
• Mfd. after 1987	70
Motorcycle	
• Mfd. before 1975	86
• Mfd. after 1974 and before 1968	80
• Mfd. after 1977 and before 1988	75
• Mfd. after 1987	70
Other vehicle	
• Mfd. before 1975	84
• Mfd. after 1974 and before 1978	80
• Mfd. after 1977 and before 1988	75
• Mfd. after 1987	70

Under this section of the Vehicle Code, by 1988, all vehicles sold in California will have to meet the 70-decibel standard.

7. Department of Housing and Urban Development (HUD)

Because excessive noise can threaten the serenity and quality of life and indirectly cause housing deterioration, HUD's policy is to withhold support from new construction on sites having unacceptable noise exposure. In doing so, HUD has placed special emphasis on noise-compatible land use planning and treats noise studies as allowable costs in connection with HUD-assisted projects. Additionally, HUD has established minimum standards of noise exposure as guidelines for HUD support decisions. They are expressed in terms of site exposure for varying lengths of time to specified noise levels.

Another aspect of HUD's noise exposure standards concern interior noise levels. Whether or not these interior noise standards will be achieved depends on, among other things, the external noise levels, the equipment and layout used in the building, and the noise attenuation characteristics of the floors and walls. Major emphasis is placed on noise levels in sleeping quarters and sound transmission between dwelling units.

8. California Noise Insulation Standards

Beginning August 22, 1974, noise insulation standards for new hotels, motels, apartment houses and dwellings (except detached one-family dwellings), which were adopted by the Commission of Housing and Community Development, will be applied to protect occupants from the effects of excessive noise. These regulations, part of Title 25, Chapter 1, of the California Administrative Code, take the form of performance standards and are mandatory for every local jurisdiction in the State.

They deal with noise insulation from exterior sources and with sound transmission between dwelling units. With respect to exterior noise, buildings must be designed so that interior noise levels will not exceed an annual Community Noise Equivalent Level (CNEL) of 45 decibels with all doors and windows closed. The CNEL scale, similar to the Ldn scale, typically varies from Ldn by no more than a few tenths of one decibel. The specification of the annual CNEL is an attempt to account for seasonal variations in outdoor conditions that would significantly affect noise levels. The regulations come into play whenever a structure is proposed to be located within an exterior annual CNEL contour or zone of 60 decibels, as established by the noise element. In such a case, an acoustical analysis report must be submitted showing how the 45 CNEL interior noise standard will be achieved.

Sound transmission control between dwelling units and guest rooms in hotels and motels is required by the noise insulation standards irrespective of outdooe noise levels. Sound Transmission Class and Impact Insulation Class standards must be met by wall and floor-ceiling assemblies.

9. San Francisco's Noise Control Ordinance

For years San Francisco attempted to regulate excessive noise--chiefly amplified sound--by applying the law of general nuisance. Growing understanding of the problems of effective noise control resulted in the passage in 1972 of a comprehensive noise control ordinance with stated decibel limitations, depending on time and distance. It deals with noises not related to transportation, except for motor vehicles operated off the public streets. The noise sources regulated are:

- Construction equipment.
- Waste disposal services.
- Motor vehicles off the public streets.
- Stationary machinery or equipment.
- Vehicle and non-stationary source repairs.
- Powered model vehicles.
- Miscellaneous transient noises.
- Noise from adjacent units of multiple-family residential buildings.

Unlike the former general nuisance-type approach toward noise regulation, the ordinance embodies the concept of land use compatibility, taking into account land use districts, noise level, and time of day or night. Enforcement personnel use sound level meters to assure both the objectivity and accuracy needed for successful enforcement.

The Noise Control Ordinance also authorized the formation of a Task Force on Noise Control composed of seven designated City department heads and 15 other persons representing a cross-section of technical and community interests. The Task Force is currently evaluating the Noise Control Ordinance with the objective of recommending any changes or amendments that may prove necessary in the light of experience gained since the ordinance went into effect.

10. California Office of Noise Control

The California Noise Control Act of 1973 established the Office of Noise Control in the State Department of Health. The function of the Office of Noise Control is to coordinate State activities and establish and maintain a program on noise control. In actual operation, the Office will continue and expand on programs already in existence in the State Department of Health.

PROPOSED ACTIONS

The Federal and State programs to combat noise offer the promise of a more quiet environment. Other techniques can be initiated at the local level. The following recommended actions represent the entire range of available ways of dealing with transportation-related noise. As such, they should be employed selectively with an eye toward financial feasibility as well as effectiveness.

1. Enforcement of State Vehicle Code Operational Noise Standards

Since the Police Department set up its Noise Abatement Unit, with sound level meters, hundreds of motorists have been cited each month for violation of the State Vehicle Code standards. Diligent, continuous enforcement of these vehicle noise standards will contribute significantly toward controlling noise at the source.

2. Modification of Municipal Railway Vehicles

The City's fleet of eight-cylinder GMC transit coaches, streetcars, and cable cars have proven to be a significant contributor to the noise environment. New streetcars (expected to be relatively noisy) are on order, but the cable cars are permanent.

Most of the existing buses will remain in service for perhaps another ten years, and the 1995 projected noise levels anticipate the replacement of the present bus fleet by quieter buses. Early steps to quiet the existing offending buses, however, could produce noticeable results. The projected noise levels do not assume any modifications to the streetcars and cable cars. Research should be undertaken to develop techniques for modifying the cable cars (and traction system) and the new streetcars so as to cut down on the noise. In this way, the discrepancy between the noise that these vehicles and rubber-tired vehicles are expected to produce can be narrowed.

3. City Purchase of Quiet Vehicles

It is not enough for the City to purchase vehicles that must meet the State Vehicle Code Standards. By setting its own noise specifications, be they for transit or other vehicles, the City can obtain the quietest vehicles that technology can offer.

4. Restoration of Two-Way Traffic on One-Way Residential Streets

Experience has shown that when a two-way street is converted to a one-way street, traffic volume, speed, and noise generally all go up. The traffic flow benefits of one-way streets, however, can outweigh these disadvantages, especially in the congested downtown area. In residential areas, however, one-way streets may be adding an undue amount of noise to the immediate environment. Restoring two-way traffic on these streets can reduce noise levels in the immediate vicinity, at least during certain times of the day.

5. Restriction of Truck Traffic on Certain Streets

By 1988, under the present State Vehicle Code, new trucks must be as quiet as automobiles. Until then, however, heavy trucks will still present a significant noise problem. Restricting trucks to one block, for pickups and deliveries, is already in force on a number of city streets. Truck restrictions can be extended to other streets in the city. The key to such an action, regardless of how many thoroughfares are restricted in this way, is enforcement

6. Maintenance of Smooth Street Surfaces and Streetcar Rails

Rough pavement and corrugated streetcar rails are responsible for a measurable increment of transportation noise levels. High-quality street maintenance and periodic grinding of streetcar rails are called for to eliminate this source of noise.

7. Electrification of Municipal Railway Motor Coach Lines

Overhead wires for electric trolley coaches are a small price to pay for quiet, pollution-free transit. Street trees often

obscure the wires, in any case. Electrification of existing motor coach lines, especially those that must negotiate the hills, can remove an important source of disturbance.

8. Limitation on the Use of Sirens and Horns

Emergency sirens of the electronic, warbling type are particularly annoying to many persons. An ordinance to prohibit this type of siren should be considered to force a reversion to the older standard siren and remove this growing source of complaint.

9. Encouragement of Compatible Development and Prevention of Incompatible Development

Based on the land use-noise compatibility relationships, there are certain activities that are best carried on away from noisy areas and others that can co-exist with noise. Zoning can facilitate this compatibility. The zoning map and the City Planning Code should be reviewed to determine if any revisions are necessary to insure that development will be consistent with present and projected noise levels.

10. Site Design and Building Layout

Through its project review function, the Department of City Planning can suggest design changes in proposed developments to achieve noise objectives. Thoughtful placement of structures on building sites so as to minimize noise impact may include such measures as deep setbacks, orienting the narrow dimension toward the noise, taking advantage of the shielding effect of other buildings, and erecting earth or masonry barriers on the site. Room layouts that place those functions least disrupted by noise closest to the noise may be just as effective as an insulated wall or a wall with no openings.

11. Roadway Barriers and Screening

Although trees and shrubs, unless very heavily planted, can only visually screen a noise source, solid walls and earth berms or mounds are effective noise barriers. In particularly severe noise problem areas, barriers should be considered.

12. Environmental Impact Review Process

Part of the environmental impact review process is the evaluation of the noise impacts of proposed developments. These developments may be new transportation facilities or projects with significant traffic-generating potential. An analysis of the noise questions can spur the implementation of measures to mitigate any anticipated adverse noise impacts.

13. Continual Monitoring of Noise Levels

Up-to-date noise level data are needed both for proper enforcement of the building noise insulation regulations and for gauging the effectiveness of efforts to reduce environmental noise. The City should maintain a program to continually monitor outside noise levels.

14. Protected Residential Areas

This ongoing program selects residential areas for special treatment to discourage through traffic. Street narrowings and traffic diverters can be used effectively. The effect of this program, however, is to shift traffic rather than reduce it. In this respect, the net result could be to re-arrange rather than reduce the traffic noise.